



REFORMING SCHOOL MATHEMATICS IN INDIA – A SYSTEMATIC REVIEW OF NATIONAL CURRICULUM FRAMEWORK (2005)

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ABSTRACT

Mathematics is very essential and integral part of both daily life and school curriculum. It is compulsory subject in Indian education system therefore every student needs to learn Mathematics till secondary stage of schooling. Most of the students consider it as a boring subject because the curriculum presents Mathematics as a subject having no real life connection. The present study is primarily concerned with the need for reforming school Mathematics Education focusing on the principle "Learning without Burden." National Curriculum Framework (2005), a document focuses upon the curriculum load on children, calls for the learning which is a joyful experience for the learner. The prime goal of Mathematics Education is to develop the ability of Mathematization of learner's thought process. But the sad reality is that the present status of Mathematics education is far away from this goal. Much emphasis is given on the developing computational ability and rote memorization of formulas rather than understanding the concepts. The present study is an attempt to investigate the higher aims and objectives of teaching Mathematics at different school stages, broad vision to be achieved for Mathematics and various systemic reforms needed in teaching learning and assessment and evaluation procedure in India.

KEYWORDS: NCF 2005, Mathematical literacy, Ability of Mathematization, Curriculum, Teaching learning process, Assessment and Evaluation etc.

INTRODUCTION:

National Curriculum Framework (NCF) is a document that has been prepared by National Council of Research and Training (NCERT) in India by a group of Intellectual and concerned citizens. 35 members National Steering Committee including 10 members from NCERT and 21 National focus groups have been set up to have deliberation on various curricular areas, themes and concerns. The document mainly focuses upon curriculum load on children with respect to four core areas, namely, Language, Mathematics, Science and Social Sciences. The present paper concentrates only on one area Mathematics.

Mathematics is one of the fields of study that has been considered as the central component of human thinking. It can be considered as Science as well as Art and language too. There are many ways of thinking but according to NCF (2005), the thinking one should learn in Mathematics is the ability to handle abstractions. The higher aim of teaching Mathematics is to develop Children's resource to think and to reason mathematically. Developing Children's ability for Mathematization is the prime goal of Mathematics Education. Quality Mathematics Education is the right of each and every child. NCF vision for quality Mathematics could be achieved in that school Environment where children:

- Learn to enjoy Mathematics rather than fear it.
- Learn important Mathematics more than numeracy and calculations.
- See Mathematics something to talk about or communicate through and to discuss among themselves.
- Pose and solve meaningful problems.
- Use abstraction to perceive relationships, to see structures, to reason about things and to argue about truth and falsity of statements.
- Understand the basic structure of Mathematics: Arithmetic, Algebra, Geometry and Trigonometry.

But there are so many challenges in achieving the above envision of quality Mathematics in Indian Schools. Various core areas of concern which hinders the growth of children as better mathematics learner are:

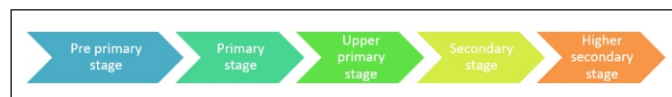
- Sense of fear and failure regarding Mathematics among majority of children
- Disappointing Curriculum for both talented minority as well as non-participating majority.
- Too much emphasis on computations in problems and exercises.
- Crude methods of assessment which focus upon the memory of formulas.
- Teacher's lack of confidence, preparation and support in teaching Mathematics.

tics.

- Compartmentalization between primary and high school teachers which results in non implementation of recommendations of various researches in Mathematics.
- Social discrimination also reflects in Mathematics as it tends to be regarded as Masculine Domain

MATHEMATICS AT VARIOUS SCHOOL STAGES:

School education is external intervention in child's life. Although much learning and teaching takes place at home and in society but the school provides the child with such teaching learning environment which is designed as per the need of the learner. While stepping in school education, every child passes through the following school stages:



Each and every stage has its own aims and objectives of teaching mathematics. The higher aim of teaching mathematics is to develop the ability of mathematization of child's thought process. To achieve this aim every stage of school education demands for a challenging curriculum. Curriculum should be organized in such a way that those aims could be achieved at maximum level. As the needs and requirements of learning mathematics at each stage is different. Hence multiple approaches depending upon the need of the learner should be followed.

- 1. Pre primary stage:** Rather than didactic communication, play way method can fulfill the higher aim of teaching Mathematics. Children need to understand number sequence rather than rote learning. Free expression of emotions and thoughts are highly emphasized at this stage.
- 2. Primary stage:** A positive attitude and liking towards Mathematics is very important at this stage. Mathematics puzzles, games and stories help to do so. While understanding the various concepts of shapes, spatial understanding, patterns, measurements and data handling. Concrete to abstract approach must be followed in the curriculum. Other than computational skills, stress must be laid on skill of explanation, estimation, approximation and communication.
- 3. Upper primary stage:** Students never enter into classrooms as blank slates. This is the stage where students get the first taste of application of abstract concepts by their previous learning and experience. From the point of view of achieving universalisation of Mathematical literacy the skills learnt at this stage are very essential. Various skills like problem solving, spatial reasoning, visualization should be an integral part of curriculum at this stage. Students understand the concept of data handling, repre-

sensation and interpretation which is very significant part of dealing with the information in daily life. Therefore, life skills should be an essential part of curriculum at this stage.

4. **Secondary stage:** At this stage students begin to perceive Mathematics as a discipline. They become familiar with carefully defined terms, concepts, symbols, formulas, propositions and proofs which justify propositions. This stage concentrates maximum on developing problem solving ability of students. Algebra is an integral part of curriculum of secondary stage to achieve high level of mathematical literacy because algebra is important not only in Mathematics but also within mathematics for justifications and proofs.
5. **Higher secondary stage:** The main aim of mathematics at higher secondary stage is wide variety applications of concepts learnt in the previous stages. Therefore, curriculum should be equipped with all the basic tools which enable such application. The rapid explosion of mathematics as a discipline favors an increase in breadth of the concepts rather than depth. This is possible only when the treatment of topics in the curriculum must have mathematical insight and communication of concepts which in turn arouse the interest and curiosity of students.

Various approaches to be followed at different stages for achieving higher aim of Mathematics education has been given in the following table:

Table 1: Multiple approaches at different school stages

Pre primary stage	Primary stage	Upper primary stage	Secondary stage	Higher secondary stage
Play way method	Mathematics puzzles	Problem solving skill	Logical thinking	Application of concepts
Free expression of thoughts	Mathematics games	Spatial reasoning and abstract thinking	Generating knowledge	Mathematics as a discipline
Discouraging rote learning	Mathematics stories	Visualization and life skills	Creativity	In depth understanding of the concepts
Understanding number sequence	Positive attitude towards Mathematics	Mathematization of children's thought	Deep engagement with the concepts	Mathematical communication

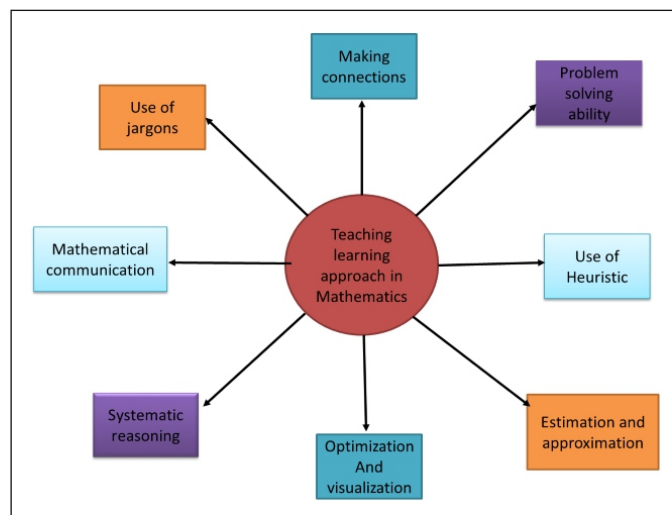
GUIDELINES FOR TEACHING LEARNING PROCESS OF MATHEMATICS:

NCF vision of quality mathematics demands meaningful and purposeful teaching learning process which can link education with daily life and develop a positive attitude towards the subject. Enriching teaching learning process with such pedagogic techniques which ensures the overall development of children rather than remaining textbook centered will help in universalization of mathematical literacy. Quality mathematics demands a teaching learning process in which students constructs their own knowledge from their experience and environment rather than rote learning and memorization. NCF suggests a teaching learning process which mainly emphasizes on inculcating following skills:

1. Formal problem solving should be included in teaching of Mathematics which is an essential skill. Techniques like abstraction, quantification, analogy case analysis, guess and verify are useful in many problem context. When the tool kit of the students becomes richer, they will learn which approach is best and when.
2. Use of Heuristics or rule of thumb should be emphasized because this approach encourages communication of Mathematical thought through discovery by drawing diagrams, examining special cases, specializing and generalizing the solution.
3. Skill of Estimation of quantities and approximating solution should be included in teaching learning process. When exact is not available, to be approximate is very essential. For instance, when a farmer estimates the yield of particular crop, skill of estimation and approximation is used. But the reality is these skills are almost entirely ignored in the present curriculum.
4. Optimization which means best use of available information is not even recognized in the entire teaching learning process. The teaching should be designed in such a way that students should make aware of the fact there are two possible routes to arrive at same destination and each has its own advantages and disadvantages. Taking care of these advantages and disadvantages, one can choose the best way to arrive at a solution.
5. Visualization and representation skills, helps in discarding the irrelevant

information, should be an integral part of classroom teaching. For instance, a fraction can be written in p/q form but it can also be visualized as point on number line. Both representations are useful and helpful in different contexts.

6. There is also a need for making connections within Mathematics and between mathematics and other subjects. Students learn how to draw graphs but they fail to think of graphs when encountering equations in physics and chemistry.
7. Such teaching should be encouraged which promotes Systematic Reasoning which in turn will help in developing skills of argumentation, evaluation of arguments and making connections. Proofs of various theorems should be presented in a systematic way of argumentation.
8. Another important element of teaching process should be Mathematical communication. The use of jargon in mathematics is deliberate, conscious and stylized. Appropriate notions should be discussed because good notions are considered to aid thought process.



Inclusion of above mentioned skills in teaching and learning Mathematics requires multiplicity of approaches, procedures and solutions. When many ways are available, one can compare and decide which is appropriate and when.

ASSESSMENT AND EXAMINATION REFORMS:

Another crucial area of concern in school education is assessment of student's learning. It is very important to focus upon student centered learning. The present Indian school board exams do not serve the needs of 21st century. The quality of examination is low and calls for only rote memorization. It fails to test the higher order thinking skills like reasoning and analysis. It is highly inflexible and based upon the principle of 'one size fits all'. Mass media and various psychological counselors reports a growing number of exam induced suicide and nervous breakdown. There is also lack of transparency in grading and reporting system. Hence there is a great need for a functional and reliable system of assessment and evaluation. Follow up of NCF 2005 suggests the following reforms in assessment and examination system:

- There should be scope for a student to achieve learning in a flexible time frame and accumulate credits, eliminating tests of fixed duration and adopting CCE. The mark sheet must include a portfolio (David wheeler, 2001) that would accommodate a student's performance in various domains like life skills, personal qualities etc.
- Paper setting also needs drastic reforms. Short questions be reduced and replaced with Multiple Choice Questions (MCQs) on one hand and reflective (long answer) type questions on the other. The focus should be shifted from paper setting to question setting. Careful selection of questions from teachers, college professors and educators from other states should be there which in turn provides us with more innovative questions.
- 'One size fit all' principle must be highly discouraged. Examination system needs to be more flexible. There is a lot psychological data which suggests that different learners learn differently. Therefore it is unfair to test all the learners with the same question paper.
- The focus should be shifted from direct testing by boards to school based and teacher based assessment to make the procedure of evaluation as a continuous process rather than a one shot measure. The teacher should be the primary evaluator of the students.

Therefore, NCF articulates major shifts in examination and assessment procedure as follows:

Table 2: Major shifts in the Assessment and examination procedure

From	To
• One shot measure	• Continuous process
• One size fit all	• More flexible
• Paper setting	• Question setting
• Short answers and essay type questions	• MCQ (Multiple choice question), oral testing and practical examination
• Rote learning	• Understanding and application of knowledge
• Stressful and forceful activity	• Student centric where they enjoy learning
• Fixed duration and framework	• Flexible time framework
• Various systemic and evaluating errors	• Transparency

CONCLUSION:

It has been observed from the follow up of NCF 2005 that remarkable changes are needed in mathematics in India. Meaningful and learner friendly Mathematics is the requirement of 21st century. Each child should understand to apply mathematics in his day to day life. Sense of fear and failure of the subject should be replaced by joyful learning. The NCF vision for quality mathematics education is based upon the premises that all the students should learn mathematics better as well as better mathematics. The purpose of learning Mathematics should ensure to develop children's intellectual capabilities to become better thinkers and effective problem solvers. It is therefore imperative that highest quality of mathematics education should be offered to all children which will be possible through proper planning and effective implementation.

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